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Private landowners' willingness-to-pay for certifying forestland and influencing factors: Evidence from Arkansas, United States

Nana Tian[a,*], Elena C. Rubino[a], Jianbang Gan[b], Ana Gutierrez-Castillo[c], Matthew Pelkki[c]

[a] Arkansas Forest Resources Center, College of Forestry, Agriculture & Natural Resources, University of Arkansas at Monticello, Monticello, AR 71656-3468
[b] Department of Ecology and Conservation Biology, Texas A&M University, College Station, TX 77843
[c] Arkansas Center for Forest Business, College of Forestry, Agriculture & Natural Resources, University of Arkansas at Monticello, Monticello, AR 71656-3468

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ABSTRACT

Forests offer provisioning, regulating, cultural, and supporting ecosystem services, and sustaining these services is becoming increasingly important. Forest certification programs serve as a viable market-based mechanism for enhancing sustainable forest management and achieving broader sustainability goals. However, certification cost has consistently been identified as a substantial barrier to enrollment in forest certification, especially for small non-industrial private forest (NIPF) landowners. We explored NIPF landowners' willingness-to-pay (WTP) for adopting forest certification and compared it with certification cost. Using a state-wide landowner survey, we estimated average WTP for certifying forestland in Arkansas, USA. We also employed Tobit regression to explore factors that influence the WTP. We found that the average WTP for certification was US$12.10/property, considerably lower than average certification cost (US$75/property). However, among respondents who had a non-zero WTP, the average WTP was US$57.60/property. Moreover, we found that landowners WTP was positively related with gender, income, length of land tenure, intention of family legacy, interest in adopting forest certification, motivations for timber production and recreation, and price premium benefits; whereas it was negatively correlated with hunting and farming motivations and beliefs about expanded markets and increased paperwork. While targeting the landowners with attributes that influence WTP may help increase the certification enrollment of NIPF landowners, the broader success of forest certification entails reaching out to the majority proportion of NIPF landowners who are not yet willing to pay for certification programs. In addition to better connecting with NIPF landowners, bridging the gap between the WTP for certification and certification cost, for example, via providing joint certification for multiple landowners and incentive programs (e.g., tax reductions, cost sharing), is essential to expand NIPF landowners' participation in forest certification.

1. Introduction

Forests provide an array of provisioning, regulating, cultural, and supporting ecosystem services that are critical to economic growth and livelihoods. Such services include timber, carbon storage/sequestration, air and water regulation, soil conservation, wildlife habitat, biodiversity, and cultural, recreational, and spiritual values (Acharya et al., 2019; Paluš et al., 2021). As the state of forest ecosystems has significantly declined at a global scale, sustaining these ecosystem services is becoming increasingly important (Acharya et al., 2019). As such, there have been targeted efforts to better plan and design forest management strategies and practices with forest sustainability in the context of broader forest ecosystem services in mind. Although many of these efforts have taken the shape of public policies, employing similar principles in a private market setting has served as the basis for the development and deployment of forest certification programs (Paluš et al., 2021).

Forest certification programs are voluntary, market-based approaches to promote sustainable forest management. Globally, approximately 430 million hectares (1.06 billion acres) of forestlands are currently certified (Fernholz et al., 2021), accounting for approximately 10% of global forestland cover. The market-based nature of certification programs is particularly important for geographies where substantial portions of forestlands are under private ownership, as certification could provide social recognition of private landowners for responsible forest practices to achieve sustainable management goal (Tian et al., 2018a; 2018b). For example, in the United States, 58% of forestlands are smaller, privately-owned parcels, but few small private forestland owners have participated in forest certification (Fernholz et al., 2021), representing a significant opportunity and an urgent need for enhancing

* Corresponding author.
E-mail addresses: tian@uamont.edu (N. Tian), rubino@uamont.edu (E.C. Rubino), j-gan@tamu.edu (J. Gan), gutierrez@uamont.edu (A. Gutierrez-Castillo), pelkki@uamont.edu (M. Pelkki).

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forest management and achieving sustainability goals through enrolling these landowners in certification programs. In addition, counterfactual evaluations of forest certification impact require more forest management units (FMU) to evaluate; therefore, have more private landowners to adopt certification is necessary for providing more evaluation FMU (Romero et al., 2017; Rana and Sills, 2018). The current accessible and commonly used forest certification organizations in Arkansas mainly include the Forest Stewardship Council (FSC), the American Tree Farm System (ATFS), and the Sustainable Forestry Initiative (SFI). Those three certification programs have differences in scheme's standards and processes and targets. For example, ATFS is the primary certification program for nonindustrial private forest landowner (NIPF) landowners in Arkansas, with approximately 5% of NIPF (~ 487,826 acres) land certified under this program. Many studies have examined the factors that influence landowners' interest in forest certification (Kilgore et al., 2007; Mercker and Hodges, 2007; Perera et al., 2007; Leahy et al., 2008; Crow and Danks, 2010; Ma et al., 2012; Tian et al., 2018ab; Tian and Pelkki, 2021). Education level and household income are found to be positively associated with landowners' interests in participating in a certification program (Ma et al., 2012; Tian et al., 2018a). Landowners with a larger forestland size, management plan, and timber production plan are reported to be more likely to adopt a certification program (Tian et al., 2018a; Tian and Pelkki, 2021). The finding on the influence of gender on certification enrollment is inconsistent; for example, Knoot et al. (2015) reported that female landowners in Wisconsin are more inclined to participate in conservation programs including certification, whereas Tian and Pelkki (2021) reported that male landowners in Arkansas are more interested in certification adoption.

Much research has also been conducted to document and examine the potential certification adoption constraints faced by non-industrial private forest (NIPF) landowners. Low familiarity with forest certification schemes (Butler, 2008) and forest management plan requirements (Kilgore et al., 2007; Leahy et al., 2008) has been identified as barriers to certification adoption, yet the primary barrier that emerges from the literature is the cost of enrollment, particularly for small landowners (Molnar et al., 2004; Tikina et al., 2008; Leahy et al., 2008; Ma et al., 2012; He et al., 2015; Tian et al., 2018ab; Tian et al., 2021). For example, in the US, certification cost was found to be the primary constraint for certification adoption for private landowners in Minnesota (Kilgore et al., 2007) and Arkansas (Tian and Pelkki, 2021); private landowners were neither affordable nor willing to bear certification costs in Louisiana and Mississippi (Perera et al., 2007).

Given that cost is a major barrier to enrollment in forest certification, exploring NIPF landowners' willingness-to-pay (WTP) for adopting a certification program is a prudent first step in seeking to increase program enrollment. Such information is crucial to determining the long-term viability of certification programs and developing and deploying supplemental policies and programs to promote certification. To address this, we conducted a statewide survey of NIPF landowners in Arkansas regarding the maximum amount they would be willing to pay for certification of their forestland. We then used this information, in conjunction with landowners' demographics, preferences regarding certification-program requirements, and forestland ownership motivations, to understand the factors influencing NIPF landowners' WTP for certification. Based on these results we offered recommendations for designing future complementary compensation-related policies (e.g., taxation reduction) and incentive-based mechanisms (e.g., cost-share programs) to encourage private forest landowners to participate in forest certification programs.

2. Methods

2.1. Study area

Approximately 5% of Arkansas' gross domestic product is attributed to forestry, which is the highest of all southern states in the US. (Pelkki and Sherman, 2020). Furthermore, more than half of forestlands in Arkansas is owned by some 345,000 NIPF landowners, which represents over 4.2 million hectares (10.4 million acres); yet only 5% of these privately-owned forestlands is certified (Tian and Pelkki, 2021). Currently, the American Tree Farm System is the main forest certification program used by NIPF landowners in Arkansas as other certification programs (e.g., the Forest Stewardship Council, the Sustainable Forestry Initiative) are primarily targeting industrial landowners. Given the limited adoption of certification programs among NIPF landowners, Arkansas is exemplary of great potential to increase the enrollment of NIPF landowners in forest certification in the United States and other countries with significant private forestland ownership. Increased certification enrollment would enhance the sustainable management of private forests and improve NIPF landowners' ability to enter markets that increasingly require certificated wood fiber (Tian and Pelkki, 2021; Tian et al., 2022).

2.2. Data collection

To analyze NIPF landowners' WTP for certification, we conducted a survey of Arkansas' NIPF landowners who owned 10 acres (4.05 ha) or more of forestland (Butler, 2008). We administered a mixed-mode survey (mail and online) to a sample of 4,000 landowners in 2020. These landowners were randomly selected from the population of all NIPF landowners in the state. Landowners' names and addresses were obtained from Dynata Inc. We followed Dillman, (2014) tailored design method of survey implementation and provided landowners with a push-to-web link to the online survey or the option to mail back the completed questionnaire in a prepaid return envelope. Of the original 4,000 surveys we mailed, 298 were returned due to invalid addresses, deceased landowners, land-use changes, or no forestland owned. We received a total of 562 usable responses, yielding an effective response rate of 15.2%, which is comparable with other similar landowner surveys (Nicosia et al., 2014). Budget limitations prevented us from conducting a non-response bias follow-up survey. We did, however, compare the demographics of landowners who completed our survey with those of landowners included in the National Woodland Owner Survey (NWOS) in Arkansas (Butler et al., 2018) and found considerable similarities between the participants in the two studies. For example, the average age of landowners in our sample was 61 years and 71% of them reported as male landowners, while the average age was 67 and 78% were indicated as male in the NWOS. Moreover, 47.7% reported a college degree or higher in our sample in terms of education level and it was 46% in the NWOS.

The survey instrument contained 28 questions in three sections. Section one requested information about forestland acreage, acquisition mode, years of ownership, timber harvest intention, forest management plan, professional management advice, and ownership motivations (Tables 1 and 2). Section two included questions regarding landowners' familiarity with and knowledge of forest certification, including their level of interest in certification and perceptions of certification benefits and drawbacks (Tables 1 and 2). This section also presented the WTP for a certification elicitation scenario via the payment-card (PC) method (Tian et al. 2011), asking landowners to select their maximum WTP from six bid amounts: $0, $50, $75, $100, $150, and $200. The respondents' WTP values can be determined directly from the original data and another advantage of using PC method is that the indicated WTP values are values that respondents are confident about (Ready et al., 2001). Moreover, there is no staring point bias in the PC method for measuring WTP. These bid amounts were based on current certification costs of about $75 per contiguous property (AFA, 2022). In the last section, landowners were asked to provide sociodemographic information, including their age, gender, education, and annual household income (Table 1).

Table 1
Descriptions of variables representing landowners' willingness-to-pay for forest certification and their demographics, forestland and ownership characteristics, and attitude towards forest certification.

Variable	Mean (S.D.)	Description
Dependent variable		
WTP	12.10 (24.49)	Discrete variable, landowners' willingness-to-pay for participating in a forest certification program (US$/property)
Independent variables		
Sociodemographic variables		
AGE	61.30 (13.5)	Continuous variable denoting the age of landowners (years)
GENDER	0.71 (0.45)	Binary variable (1 = male, 0 = female)
EDUCATION	3.72 (1.52)	Ordinal variable representing landowners' highest education level with 1 = lower than high school, 2 = high school/GED, 3 = some college, 4 = associate degree, 5 = bachelor's degree, 6 = advanced degree
INCOME	3.20 (1.29)	Ordinal variable representing landowners' annual household income level with 1 = less than $20,000, 2 = $20,000 - $49,999, 3 = $50,000 - $79,999, 4 = $80,000 - $100,000, 5 = more than $100,000
Forestland and Ownership characteristics		
SIZE	30.15 (87.42)	Continuous variable denoting the size of forestland owned by landowners (hectares)
ACQMODE	1.30 (1.19)	Categorical variable representing landowners' acquisition mode for their forestland (1 = purchased, 2 = inherited, 3 = rented)
TENURE	33.15 (30.80)	Continuous variable denoting the number of years forestland has been owned by landowners (years)
HARPLAN	0.37 (0.48)	Binary variable denoting whether landowners intend to harvest timber in the near future (1 = Yes, 0 = No)
MANAPLAN	0.17 (0.38)	Binary variable denoting whether landowners have a management plan (1 = Yes, 0 = No)
MANA_ADVICE	0.69 (0.46)	Binary variable denoting whether landowners received outside management advice (1 = Yes, 0 = No)
PLAN_FORLAND	0.94 (0.22)	Binary variable denoting future ownership plan for their forestland, i.e., whether landowners intend to keep it in their family such as continuing self-management or family inheritance (1 = Yes, 0 = No)
Landowners' attitudes towards certification program		
FAMI	1.58 (1.02)	Ordinal variable denoting landowners' familiarity with forest certification (1 = not familiar at all, 5 = very familiar)
INTERE	1.84 (1.12)	Ordinal variable denoting landowners' interest in adopting forest certification (1 = not interested at all, 5 = very interested)

Table 2
Descriptions of variables representing ownership motivations and perceived benefits and drawbacks.

Variable	Mean (S.D.)	Description
Ownership Motivations		
SCENERY	4.40 (2.45)	Importance of owning forestland for scenery
NATURE_PRO	4.19 (1.08)	Importance of owning forestland for nature and biodiversity protection
TIMBER_PRO	2.26 (1.44)	Importance of owning forestland for timber production
FINAN_INV	2.99 (1.53)	Importance of owning forestland for long-term financial investment
PARTFARM	3.41 (1.55)	Importance of owning forestland as part of farm
HAB_SUPPLY	3.90 (1.20)	Importance of owning forestland for supplying food and habitat for wildlife
HUNTING	3.33 (1.55)	Importance of owning forestland for hunting/fishing
RECREATION	3.31 (1.40)	Importance of owning forestland for other recreational activities
PRIVACY	4.24 (1.17)	Importance of owning forestland for privacy
HERITAGE	3.09 (1.66)	Importance of owning forestland for family heritage
HAVETREES	3.92 (1.27)	Importance of owning forestland for conserving trees
GRAZING	2.39 (1.92)	Importance of owning forestland for livestock grazing
Perceived benefits and drawbacks		
TIMBER_INCR	3.41 (1.42)	Agreement level on improving timber growth and health with certification
MARKET_EXP	2.67 (1.42)	Agreement level on expanding markets for harvested forest products with certification
PRICE_PRE	2.78 (1.47)	Agreement level on having price premiums for certified forest products with certification
PUBREC	2.63 (1.45)	Agreement level on public recognition for practicing responsible forest management after certifying
ENVFRI_HAR	3.10 (1.48)	Agreement level on adopting environmentally-friendly timber harvesting with certification
ENG_MANA	3.32 (1.44)	Agreement level on enhancing forest management after certification
COST_INC	2.84 (1.36)	Agreement level on increasing management costs with certification
PAPER_INC	2.89 (1.39)	Agreement level on increasing paperwork and record keeping with certification
ONSITE_INSP	2.60 (1.38)	Agreement level on increasing on-site inspections with certification
FOLLOW_MANA	2.63 (1.37)	Agreement level on following a management plan with certification
DIVER_DEC	2.65 (1.64)	Agreement level on decreasing harvesting diversity with certification

Note: All variables were ordinal variables measured on a 5-point Likert scale with 1 = "do not agree at all", 5 = "strongly agree".

2.3. Econometric modeling

We adopted descriptive statistics, analysis of variance (ANOVA), and Tobit regression to analyze the survey data using the Statistical Analysis System (SAS) software. We first employed an ANOVA analysis to test for differences between two groups of landowners at a 0.05 significance level. The first group was respondents who answered with $0 WTP (i.e., unwilling to pay for certification) and the second group was those who chose any positive amounts of WTP. The ANOVA analysis identified differences between these two groups in terms of socio-demographics (e.g., age, education, household income), forestland characteristics (e.g., tenure, land size), future ownership plans (e.g., continue to self-manage or sell/rent forestland), and landowners' attitudes towards certification (e.g., familiarity with certification).

We then used Tobit regression analysis to explore the factors influencing landowners' WTP. Following Lindhjem and Mitani (2012) and Brander et al. (2006), landowners' WTP for a conservation program can be specified as a function of the landowners' socio-economic charac-

teristics (demographics) and the resources' (forestland) and program's (forest certification program) characteristics. To identify and analyze the possible determinants of landowners' WTP for participating in a certification program, we included landowners' demographics, forestland and ownership characteristics, owners' attitudes towards certification, ownership motivations, perceived benefits/drawbacks of certification as covariates in the regression model (Equation 1).

$$\begin{aligned}\mathrm{WTP} = \mathrm{f}\big(&\text{Landowner demographics, Forestland and ownership}\\ &\text{characteristics, Landowner attitudes towards certification,}\\ &\text{Ownership motivation, Perceived benefits/drawbacks}\\ &\text{of certification}\big).\end{aligned} \tag{1}$$

Willingness-to-pay for participating in a certification program was measured through a contingent valuation survey, using the payment card method with multiple bid options. Different techniques have been used for linking WTP with covariates, including the commonly-used ordinary least squares (OLS) method (Lindhjem and Mitani, 2012). However, because OLS estimates are inconsistent when the dependent variable contains zero-censored values, it was not applicable in this study due to the zero-censored values of WTP. By contrast, Tobit regression can provide consistent estimates in such cases, making it the preferred model for this study (Tobin, 1958; Ammmemiya, 1984; Halstead et al., 1991; Martín-López et al., 2007). The landowners' WTP for certification served as the dependent variable in the Tobit regression model (Equation 2) and the independent variables were those included in Equation 1 (see also Tables 1 and 2).

$$WTP_i = \beta_0 + x_i'\beta + \mu_i \tag{2}$$

In this equation, i denotes an individual landowner, x_i' denotes the vector of the covariates included in this study, β represents the vector of coefficients, β_0 denotes the intercept, and $\mu_i$is the error term which follows a normal distribution.

The covariates describing landowners' demographics consisted of age, gender, education, and household income. In terms of forestland and ownership characteristics, we included land size, acquisition mode, tenure (duration of ownership), presence of a forest management plan, intension for timber harvesting in the near future, external management advice, and future ownership plans (Table 1). Two variables were used to measure landowners' attitudes towards certification: landowners' familiarity with forest certification and their interest in certification (Table 1). Ownership motivations included 12 items measuring the importance of each motivation on a 5-point Likert scale (1 = not important at all, 5 = very important; Table 2). The final category of covariates measured landowner agreement with statements regarding their perceived benefits/drawbacks of certification on a 5-point Likert scale (1 = not agree at all, 5 = strongly agree; Table 2).

3. Results

3.1. Profile of landowners groups

Of the 524 respondents, about 80% (n = 420) indicated their willingness to pay for forest certification was $0 while others (n = 104) reported a positive amount of dollars for certification. ANOVA detected distinct differences between landowners with $0 of WTP (the NO WTP group) and those with a positive WTP (the YES WTP group) with regards to their socio-demographics, forestland characteristics, and interest in participating in a certification program (Table 3). Significant differences were also found in average age, education, and household income between those two groups. The landowners in the YES group tended to be younger, obtain more formal education, and receive higher household incomes than those in the NO group. Specifically, the average age of the YES group was 55 years, compared to 63 years of the NO group. The percentage of respondents who obtained a Bachelor's or higher degree was significantly larger in the YES group (60.50%) than in the NO group (32.6%), while the percentage of who did not complete high school/GED was markedly lower in the YES group (10.6%) than in the NO group (27.1%). Similarly, 11.8% of the YES group reported that their annual household income was between $20,000 - $49,999, while 31.5% of the NO group indicated that they were in this income category. A greater percentage of respondents in the YES group (40.2%) than in the NO group (19.4%) indicated that their annual household income was greater than $100,000.

No significant differences between the YES and NO groups were found in the size and tenure of forestland they owned, their possession of a forest management plan, and their plan to harvest timber in the next five years. However, a significant difference was found in the answer to whether they had received management advice from others. Nearly 70% of respondents in the YES group reported that they had obtained management advice from others, compared to 49% in the NO group. Additionally, respondents in the YES group indicated a stronger interest in certifying their lands than those in the NO group. The positive correlation between the WTP and interest in the certification, though obvious, reveals the consistent responses from the survey participants to these two separate but related questions.

3.2. Landowners' average WTP and affecting factors

Fig. 1 shows the relationship between the percentage of landowners who would participate in forest certification and their WTP for certification. Among all survey respondents, the average WTP to have their forestland certified was US$12.10/property, which is substantially lower than the current certification cost in the region (US$75/property). However, the WTP increased to US$57.60/property for the landowners who indicated a non-zero WTP for certification (YES group). Approximately 17% of the landowners surveyed were willing to pay for US$50 to have their forestland certified. The percentage of landowners' participation in forest certification declined rapidly with an increase in the WTP when the WTP was less than US$75/property.

To address potential multicollinearity concerns among the independent variables in the Tobit regression model, we computed the index of variance inflation factors (VIFs) (Table 4). All the VIFs were less than the critical cutoff value of 10 (Ghimire et al., 2014), suggesting that multicollinearity was not a concern in the model. The statistical associations between the WTP and independent variables are shown in Table 4. Only the associations that showed statistically significant at the 5% or lower significance rate are described below.

Among the sociodemographic variables, gender and income were positively and significantly associated with the respondents' WTP. This implies that male respondents were more willing to pay for forest certification than female respondents and respondents with a higher household income had higher WTPs for certification. In terms of forestland and ownership characteristics, landowners who were intended to keep/manage land for/by their families (e.g., bequeathing to family, continuing to self-manage) had higher WTPs for certification than others (e.g., sell/rent forestland). This suggests that family legacy was consistent with the benefits of forest certification. Among the variables measuring landowners' perceptions of certification, we found a positive and significant association between respondents' interest in forest certification and their WTP. This further confirms that respondents' interest in certification programs echoed their WTP for certification.

Ownership motivation for timber production was also positively and significantly related to the WTP for certification. By contrast, landowners who owned forestland for hunting had a lower WTP for certification than those who did not consider hunting an ownership objective. Among the variables describing the perceived benefits and drawbacks of forest certification, we found a significant and negative association between record-keeping/paperwork and WTP and a positive and significant association between the price premium and WTP. These may all be attributable to potential benefits and costs associated with forest certification. Certification may benefit timber producers as timber harvested

Table 3
Demographics of survey respondents and their ownership characteristics for two landowner subgroups who expressed zero and a positive value of willingness-to-pay (WTP) for forest certification.

Variable	WTP for forest certification (YES: WTP > 0; NO: WTP = 0)	
	YES (n = 104)	NO (n = 420)
AGE (mean, years)	55.0[a]	62.7[b]
GENDER (% of landowners)		
– Male	72.1	69.6
– Female	24.0	28.4
EDUCATION (% of landowners)		
– Less than 12th school	1.9	3.7
– High school/GED	10.6[a]	27.1[b]
– College education	16.3	27.6
– Associate degree	10.6	9.0
– Bachelor's degree	36.5[a]	18.5[b]
– Advanced degree	24.0[a]	14.1[b]
INCOME (% of landowners)		
– Less than $20,000	1.0	9.1
– $20,000 - $49,999	11.8[a]	31.5[b]
– $50,000 - $79,999	27.5	27.2
– $80,000 - $100,000	19.6	12.6
– More than $100,000	40.2[a]	19.4[b]
SIZE (mean, hectare)	32.3	27.2
TENURE (mean, years)	29.9	34.1
MANAPLAN (mean, proportion of Yes)	0.23	0.16
HARPLAN (mean, proportion of Yes)	0.28	0.14
MANA-ADVICE (mean, proportion of Yes)	0.70[a]	0.49[b]
PLAN_FORLAND (% of landowners)		
–continue to self-manage it	56.6	53.0
–sell/rent it	4.0	5.1
–pass it to family	39.4	41.9
FAMI (mean, 1-5 Likert scale)	1.7	1.5
INTERE (mean, 1-5 Likert scale)	2.8[a]	1.6[b]

Note: All variables are described in Tables 1 and 2. Superscripts a and b indicate that the two subgroups were statistically different at the 5% significance level.

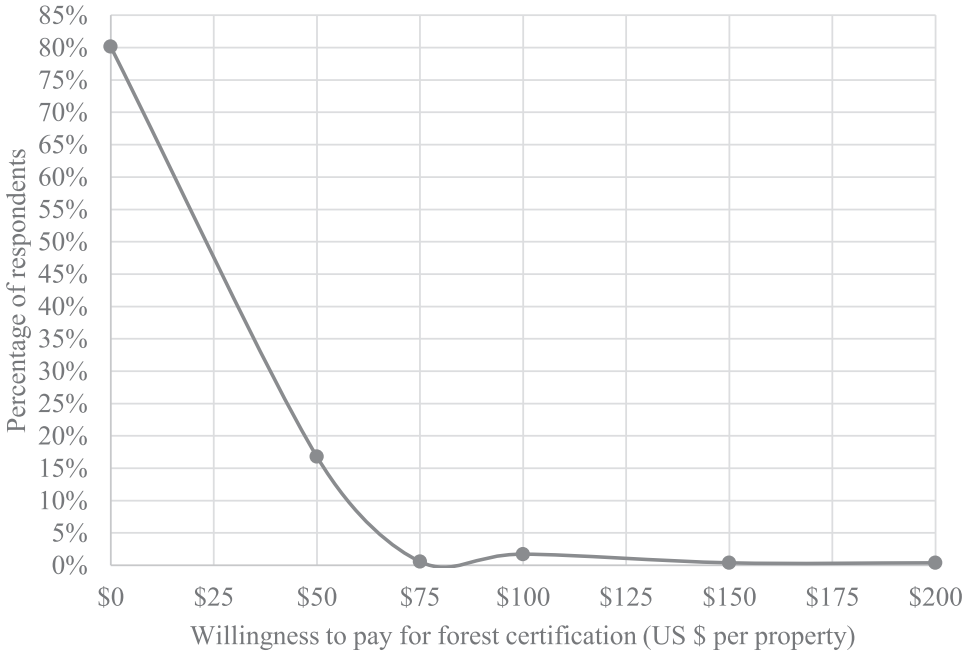

Fig. 1. Relationship between the percentage of landowners wanting to participate in forest certification and their willingness-to-pay.

from a certified forest is likely to receive a price premium. However, certification may present some barrier to hunting and the increased record-keeping/paperwork due to certification would incur additional costs to landowners.

4. Discussion

The majority (80%) of NIPF landowners surveyed in this study still did not want to pay for forest certification, which was similar with Louisiana and Mississippi NIPF landowners who indicated a $0 WTP (77%) for certification in an earlier study (Perera et al., 2007). The average WTP of all landowners surveyed, $12.10/property, is substantially lower than the annual certification cost, US$75 for certifying a contiguous tree farm property through the Arkansas Tree Farm Program (affiliated with the American Tree Farm System) (AFA, 2022). Only a small fraction (<5%) of NIPF landowners participating in our study were willing to pay US$75 or more for certification. Hence, it is essential to reduce certification costs and/or increase certification benefits to

Table 4
Tobit regression results and affecting factors for landowners' willingness-to-pay (WTP) for certifying their forestland.

Variable	Coefficient (Std. err.)	P-value	VIF
Sociodemographic variables			
AGE	-0.68 (0.50)	0.176	1.91
GENDER	32.54 (15.44)	0.035**	1.36
EDUCATION	6.06 (4.32)	0.161	1.67
INCOME	19.27 (6.16)	0.002***	2.06
Forestland characteristics			
SIZE	0.008 (0.05)	0.864	1.86
ACQMODE	-32.06 (19.83)	0.111	1.68
TENURE	0.39 (0.21)	0.063*	1.95
HARPLAN	-8.48 (12.61)	0.501	1.63
MANAPLAN	-27.92 (17.83)	0.117	1.61
MANA_ADVICE	1.01 (15.74)	0.949	1.50
PLAN_FORLAND	14.76 (6.44)	0.021**	1.35
Landowners perception on certification program			
FAMI	4.77 (5.79)	0.409	1.50
INTERE	19.91 (6.21)	0.001***	1.98
Motivations of landowners for owning forestland			
TIMBER_PRO	14.86 (5.69)	0.009***	2.52
PARTFARM	-9.51 (5.55)	0.087*	2.10
HUNTING	-16.56 (5.86)	0.005***	2.32
RECREATION	11.14 (5.87)	0.058*	2.25
Perceived benefits and drawbacks			
MARKET_EXP	-16.90 (9.11)	0.054*	7.82
PRICE_PRE	22.10 (8.74)	0.011**	7.77
PAPER_INC	-18.10 (7.74)	0.019**	4.71

Note:
*** p = 0.01;
** p = 0.05;
* p = 0.10. VIF: variance inflation factors. All variables are described in Tables 1 and 2.

landowners in order to enhance their participation in forest certification programs.

There are several ways to bridge the gap between certification costs and landowners' WTP for certification. First, compensation-related and/or incentive-based policies and programs (e.g., tax reductions, cost sharing) can be adopted to promote the enrollment of NIPF landowners in forest certification. Such programs are also justifiable as certified forests provide ecosystem services that benefit a broad scope of stakeholders beyond the landowners and have been proposed for promoting the provisions of forest ecosystem services in the US (Kilgore et al., 2017) and other countries (Nukpezah et al., 2014).

Second, certification-granting organizations can reduce the certification cost burden to individual landowners by allowing several landowners to pool them together to attaining joint forest certification. About 17% of landowners participating in our survey said that they were willing to pay US$50 to get their forestland certified (Fig. 1), and the average WTP for the landowners who indicated a positive WTP for certification in our survey was US$57.60/property. If certification organizations would allow two or more private forestland owners to pool them together to obtain forest certification, more NIPF owners are likely to participate in certification. Certification organizations can work with landowners directly or in cooperation with local landowners' associations to facilitate the pooling of landowners of adjacent forestlands and/or with similar ownership objectives and forest resource conditions. Moreover, the pooling of landowners for certification can enhance coordination among neighboring landowners in providing forest ecosystem services (e.g., water quantity and quality, wildlife habitat, etc.) and protecting their forest resources from disturbances like wildfire and pest infestation, improving the efficacy of forest management, conservation, and protection at the landscape level. Such a mechanism helping reduce transaction costs for individual farmers has been adopted in agriculture (Pingali et al., 2005) and seems practical in forestry.

Third, besides cost reductions, benefit enhancements are another alternative to encourage landowners' participation in forest certification. Given that an increasing number of timber buyers prefer to buy certified fiber (Tian et al., 2022), landowners having their forestland certified can gain market access for their timber. Additionally, landowners with certified forestland are likely to benefit from a price premium for their timber, which would offset, at least partially, the certification costs. Research has found that US consumers would be willing to pay at least a 10% premium (up to 25%) for certified wood products like household furniture and wood structure in new houses (Aguilar and Vlosky, 2007). Similarly, more than 70% of builders in the central Appalachian were willing to pay more for certified wood materials/products (Estep et al., 2013). About 40% of affordable house builders in the region were willing to pay up to 4% more for wood construction materials and another 20% of them were willing to pay 5-9% more. Willingness-to-pay among other (non-affordable) house builders was even higher, with about 20% of them willing to pay up to 4% more and another 30% willing to pay 5-9% more for certified wood products. Although it is possible to attain a price premium for certified timber, many NIPF landowners may not be strongly motivated by selling timber (Tian and Pelkki, 2021). The message that focuses on receiving higher price premiums for certified wood products may nudge NIPF landowners towards prioritizing timber sales for the management of their forestlands. Instead, communications emphasizing the value of certification for promoting non-timber ecosystem services would likely be more effective as it is in line with a top motivation for owning forestland among Arkansas NIPF landowners (Tian and Pelkki, 2021).

Tobit regression results displayed that a landowner's WTP for adopting certification was influenced by different ownership and forestland characteristics. Positive and significant coefficients were found for gender and income variables, suggesting that male landowners and higher household income landowners were more willing to pay for certification than their counterparts. Those results are not surprising given that Tian and Pelkki (2021) reported that male and higher household landowners were more interested in participating forest certification. A positive and significant effect was found for the variable of tenure which indicates landowners who own their forestland longer were more willing to pay for certification, which was consistent with the studies of

Tian and Pelkki (2021) and Ma et al. (2012), which reported that tenure was positively associated with landowner's willingness to participate in certification.

Furthermore, our findings on the factors influencing the WTP and the differences between the NIPF landowners with a positive WTP for certification and those with a $0 WTP can be harnessed by certification entities, state and federal forestry agencies, and other organizations interested in improving NIPF landowner certification enrollment. We found positive correlations of WTP for certification with household income, future ownership plan, and timber management and its negative association with bookkeeping/paperwork for certification. Certification organizations can use these findings to identify landowners for expanding certification enrollment. Landowners, who have higher household incomes and longer-term ownership plans for their forestland and consider timber production as part of their ownership objectives, are more likely to enroll in forest certification. Certification organizations should also try to minimize the bookkeeping/paperwork burden on landowners by simplifying the bookkeeping and/or providing bookkeeping assistance to landowners. We also found a strong positive correlation between receiving external forest management advice (paid and unpaid) and the WTP for forest certification. In other words, landowners who discuss forest management with professionals in either the private or public sector are more likely to enroll in certification (Tian and Pelkki, 2021; Tian et al., 2022). Thus, more efforts should be made to offer free or reduced-cost landowner outreach and assistance programs to discuss how certification enrollment may fit into landowners' management strategies.

Finally, because a dominant portion (80%) of landowners included in our study expressed a $0 WTP for forest certification, it is vital, though challenging, to reach out to these landowners for the success of forest certification in the long term. These landowners tend to be older, have less formal education, and have lower household incomes; thus, improved and innovative communication strategies are needed to connect with this group of landowners in particular and overall NIPF landowners in general (Rubino et al., 2022). For example, Khanal et al. (2019) found that older NIPF landowners with lower income levels comprised the "laggard group" with regards to participation in forest carbon sequestration programs in the southern US, and that they were strongly influenced by normative barriers to adoption and were risk-averse, making them more likely to follow well-established practices adopted by other landowners. As such, communication strategies for reaching out to the $0 WTP group may seek to demonstrate to them how other landowners have benefitted from certification enrollment, or perhaps even connect reluctant landowners with those who have enrolled in a certification program. Certification organizations should not ignore this group of landowners but should be more proactive to reach out to these landowners in cooperation with universities' Extension personnel, federal and state agencies, and professionals and consulting foresters that traditionally provide assistance to NIPF landowners. This is supported by our finding that landowners receiving professional assistance in forest management had a higher WTP for certification and the fact that landowners who are younger and have higher formal education and income levels are more likely to seek professional assistance in forest management (Chhetri et al., 2018).

5. Conclusions

This study estimated NIPF landowners' willingness-to-pay for forest certification via a landowner survey and explored its potential influencing factors with Tobit regression modeling. The results provide a better understanding of the association between landowners' WTP for certification and their demographics, preferences regarding certification program requirements, and forestland ownership motivations. The average WTP among the landowners surveyed (US$12.10/property) was substantially lower than the current average certification cost (US$75/property). Bridging the gap between the WTP and certification cost is essential to the success of forest certification in the regions like the southern US where small NIPF landowners control a large portion of forestlands. There are several options to bridge this gap, including those to reduce certification cost burdens on small landowners through providing joint certification for multiple landowners and incentive (e.g., tax benefits and cost sharing) programs. On the other hand, wood products originating from certificated forests are expected to gain market access and price premiums. While targeting landowners with higher income and education levels might be helpful for expanding NIPF landowners' enrollment in forest certification to some extent, attaining broader success in forest certification entails to reach out to the majority of NIPF landowners who are not yet enthusiastic about existing certification programs. Connecting with these landowners and especially convincing them to participate forest certification require more innovative and effective approaches including collaboration between certification organizations and professionals in both the private and public sectors who have been engaged in providing technical and financial assistances to NIPF landowners.

Our study is focused on Arkansas, a typical state in the southern US in terms of forest resource characteristics and forestland ownership structure. We recognize national and regional differences, and thus our findings may not hold in other settings. While we note this limitation, our results provide important insights that may be used to inform future research, certification programs, and related policies.

This study can be extended in several fronts, especially in searching for solutions to bridging the gap between the WTP for certification by small landowners and certification costs. The solutions may vary from case to case and from region to region. Thus, case studies from different regions under different scenarios would be helpful. Studies that will explore the linkage of actual forest certification enrollment with landowners' demographics, forestland attributes, and ownership objectives as well as forest management and protection practices adopted (Deng et al., 2015; Shrestha et al., 2021) are also encouraged. Additionally, we found that motivations for forestland ownership can have a significant effect on WTP for certification. We recommend future research to reveal the optimal channels and specific messages that resonate best with targeted groups in terms of emphasizing potential benefits (e.g., price premiums) or quelling concerns (e.g., increased record-keeping/paperwork), as we found in this study, given their ownership motivations.

Author contributions

Conceptualization, Nana Tian and Matthew Pelkki; methodology and synthesis, Nana Tian and Jianbang Gan; formal analysis, Nana Tian; writing—original draft preparation, Nana Tian, Elena Rubino, Ana Gutierrez-Castillo; writing—review and editing, Jianbang Gan and Matthew Pelkki; project administration, Nana Tian; All authors have read and agreed to the published version of the manuscript.

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Declaration of Competing Interest

The authors declare no conflict of interest.

Data Availability

The data that has been used is confidential.

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